INTEL INVENTION DISCLOSURE

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Rev. 20 – September 2003

36185

DATE: Nov. 23, 2003

WIRELESS/WCCG/PCG

It is important to provide accurate and detailed information on this form. The information will be used to evaluate your invention for possible filing as a patent application. **Invention Disclosure forms MUST be sent electronically via email to your manager/supervisor who should then forward with their approval to our email account " invention disclosure submission."** See http://legal.intel.com/patent/idf_instructions.asp
If you have any questions, please call **8-264-0444.**

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(PROVIDE SAME INFORMATION AS ABOVE FOR EACH ADDITIONAL INVENTOR)

2. Title of Invention:
A Method to Further Reduced Power Consumption in IDLE and DROWSY

3. What technology/product/process (code name) does your invention relate to (be specific if you can):
Applies to all P8x4 products, such as Manitoba/ManitobaEP, Garson, HermonA0/B0 or any other future products in this process or any more advanced processes. May also be applied to P859 for product such as Cotula.

4. Include several key words to describe the technology area of the invention in addition to # 3 above:
Drowsy, Gated Clocks Idle, P8x4, PMIC (Power Management Integrated Circuit)

5. Stage of development (i.e. % complete, simulations done, test chips if any, etc.):
Verified in simulations done. Power reduction approximation and calculations are available. A review of what it would take to implement it in hardware s given.

6a. Has a description of your invention been (or planned to be) published outside of Intel: **NO** it was not.

Exhibit __1__
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6b. Has your invention been used/sold or planned to be used/sold by Intel or others? **No** it is not.

If YES, date it was sold or will be sold:

6c. Is a SIG (special interest group) active in this technology? **No** they are not

If YES, name of SIG:

6d. If the invention is embodied in a semiconductor device, what is the actual or anticipated date of tapeout? Not at this time. Could be incorporated in any planed PMIC or even a new tapeout of an available PMIC, such as the ARAVA.

6e. If the invention is software, actual or anticipated date of any beta tests or other distribution outside Intel:

7. Was the invention conceived or constructed in collaboration with anyone other than an Intel blue badge employee or in performance of a project involving entities other than Intel (e.g. government, other companies, universities or consortia)?   XXX**NO**XXX

8. Is this invention related to any other invention disclosure that you have recently submitted? If so, please give the title and inventors: XXX**NO**XXX

9. **(Optional)** Which IP Committee do you think should review your invention disclosure based on the descriptions provided in the linked document? http://legal.intel.com/Patent/iptech.asp

PLEASE READ AND FOLLOW THE DIRECTIONS ON
HOW TO WRITE A DESCRIPTION OF YOUR INVENTION

Try to limit your description to 2-3 pages contained WITHIN THIS WORD DOCUMENT
Do NOT attach separate diagrams, presentations, white papers, or specifications
Do NOT embed other types of documents into this document

ANSWER ALL OF THE QUESTIONS BELOW

Please provide a description of the invention and include the following information:

1.   Describe in detail what the components of the invention are and how the invention works.

The essence of this invention is to further reducing the power consumption of a chip fabricated in P8x4 process during DROWSY state. It may also apply for IDLE state where all clocks are gated in the silicon. Typical chip fabricated in P8x4 process, such as Manitoba or Hermon, usually operate on a fixed 1.2 volts. A *Drowsy Indication* HW signal is used to force the PMIC to enter a high efficiency mode where Quiescent Current and charge/discharge current are dramatically reduced assuming a much lower load (up to a few percent of typical specifications). While doing so the PMIC step-down DC-to-DC Converter would be required to produce 0.95 volts on its output instead of 1.2 volts as currently done. Therefore whenever the *Drowsy Indication* HW signal is active the chip will operate on 0.95 volts instead of 1.2 volts and as a consequence its power consumption will be relatively reduced. It is important to note that since the chip overall current consumption is very low, IR drop is not expected and therefore 0.95 volts is a valid operation voltage.

With a more sophisticated PMIC this method could be performed automatically and adopted for IDLE state also. In the Automatic Mode the PMIC may sense the load reduction, i.e. current consumption is very low on the step-down DC-to-DC Converter output, and switch to the high efficiency mode. Obviously entering the high efficiency mode should not be done immediately while coming out of this mode should be performed instantly.
It is important to note that the *Drowsy Indication* HW signal can easily used to accommodate IDLE state indication. However it is suggested that it would be a conditional accommodation (through configuration). Currently this is not the case in any of Intel P8x4 products.

2.   Describe advantage(s) of your invention over what is currently being done.

Currently the PMIC step-down DC-to-DC Converter output is 1.2 volts at all times. The invention suggests that it will be forced to output 0.95 volts whenever the *Drowsy Indication* HW signal is active. By doing so the chip power consumption is expected to be relatively reduce at least by third, i.e. minimum 35%. If the voltage operation is expected to increase above 1.2 volts so the chip power consumption relative reduction is expected to increase. As an example if the voltage operation is 1.3 volts the chip power consumption relative reduction would be 45%.

With this invention leakage power dissipation in Drowsy is insensitive to the chip operation voltage.

3.   You MUST include at least one figure illustrating the invention. If the invention relates to software, include a flowchart or pseudo-code representation of the algorithm.

Connection Between P8x4 Chip and PMIC
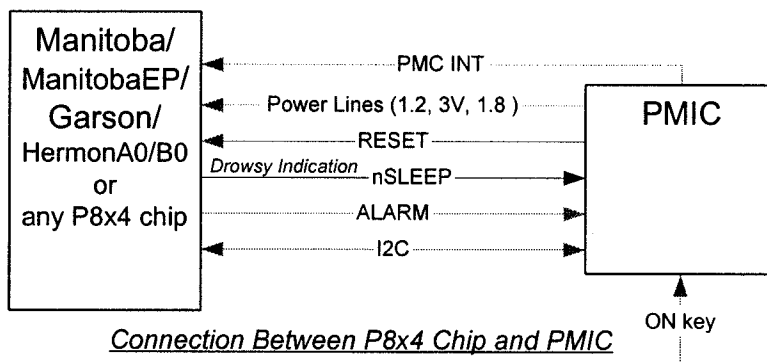
4.   Value of your invention to Intel (how will it be used by Intel or a competitor).

Leakage current on P8x4 can practically reduced by 35% therefore further show/expose the advantages of Intel process. As an example Hermon or Manitoba Standby time may be increased.

5.   Explain how your invention is novel. If the technology itself is not new, explain what makes it different.

The chip is powered on 0.95 volts only for state/data retention. This is instead of a higher operation voltage and as a consequence chip's power consumption in this 'No Activity' state is reduced. To the author's knowledge no other PMIC does this.

6.   Identify the closest or most pertinent prior art that you are aware of.

Currently PMIC's step-down DC-to-DC Converter allows a high efficiency mode where Quiescent Current and charge/discharge current are dramatically reduced. However the output voltage is constant at all times. The invention suggests that it will be forced to output lower voltage at this high efficiency mode.

Another family of PMIC introduces Dynamic Voltage change on demand. However chips like Manitoba or Hermon cannot use this technology since they need to be awake to program the PMIC and as a consequence operate on a higher voltage to perform the programming.

7.   Who is likely to want to use this invention or infringe the patent if one is obtained?

Anyone who operates a high performance processor on low voltage using advanced fabricated process with significant IR drop on power lines as well as high leakage in leakage IDLE. This is to note that the invention is the capability of the PMIC.

8.   How would infringement be detected?

The DC-to-DC Converter specification should say that during its high efficiency mode it might output lower voltage. This lower voltage should be adjustable. If the specification is not available just measure the output of the DC-to-DC Converter to see if it is changed during lowest power consumption state.

HAVE YOUR MANAGER/SUPERVISOR READ AND FORWARD THIS DISCLOSURE ELECTRONICALLY VIA E-MAIL TO "INVENTION DISCLOSURE SUBMISSION"

BY APPROVING, YOUR MANAGER/SUPERVISOR IS ACKNOWLEDGING THAT THE DISCLOSURE HAS BEEN READ AND UNDERSTOOD, AND RECOMMENDS THAT THE DISCLOSURE AWARD BE PAID